COSEWIC
Assessment and Status Report

on the

Acadian Flycatcher
Empidonax virescens

in Canada

ENDANGERED
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Acadian Flycatcher — Photo courtesy of Ron Ridout.

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COSEWIC
Assessment Summary

Assessment Summary – April 2010

Common name
Acadian Flycatcher

Scientific name
Empidonax virescens

Status
Endangered

Reason for designation
In Canada, this species is restricted to certain types of mature forest in southern Ontario. Only small numbers breed in Canada. Although the population appears to have been relatively stable over the past 10-20 years, this is most likely due to immigration from U.S. populations. The species is threatened by forestry practices, particularly those that target removal of large trees. Serious conservation concerns, both in Canada and the adjacent U.S. also stem from increasingly widespread losses of a variety of favoured nest tree species owing to the spread of an array of exotic forest insects and pathogens. Collectively, these threats to habitat greatly reduce potential for rescue from adjacent U.S. populations.

Occurrence
Ontario

Status history
Designated Endangered in April 1994. Status re-examined and confirmed in November 2000 and April 2010.

COSEWIC
Executive Summary

Acadian Flycatcher
Empidonax virescens

Wildlife species information

The Acadian Flycatcher, *Empidonax virescens*, is a drab flycatcher with olive-green upperparts, pale underparts and a pale eye-ring. This small songbird is very similar in appearance to other *Empidonax* flycatchers and is best distinguished by its distinctive *peet-sa* song and other characteristic vocalizations.

Distribution

In Canada, the Acadian Flycatcher breeds locally in southern Ontario, primarily within the Carolinian biogeographic region in southwestern Ontario. The global breeding population is restricted to eastern North America, and it is widely distributed in forested landscapes in the eastern United States. The wintering range of this Neotropical migrant extends from the Caribbean slope of Nicaragua, south through Costa Rica, Panama, Columbia, Venezuela, and Ecuador.

Habitat

Throughout its breeding range, the Acadian Flycatcher is a habitat specialist, nesting in mature closed-canopy forests with an open understorey. It favours species of nest trees that have a particular growth form. In Ontario, Acadian Flycatchers are typically found either in large patches of mature deciduous forest or in mature, forested ravine settings. In upland situations, it largely avoids forest edges and is therefore rarely found in small isolated forest fragments. In ravine situations, however, territories can be linear and the species appears to be less sensitive to edge effects. Territories range in size from 0.5 to 4.0 ha and are often situated close to streams, vernal pools, or other water features.

Biology

The Acadian Flycatcher is a late-spring migrant, with males arriving on territory in southern Ontario starting in mid-May. Pairs typically return to the same breeding and wintering territories, while young birds often disperse to other sites. Although annual site occupancy is somewhat intermittent in Ontario owing to natural turnover of individuals, the species displays strong long-term attachment to particular sites, and routinely recolonizes them so long as they retain favourable breeding habitat. The species is mostly monogamous, but up to 20% of males in Ontario have two or more females nesting in their territory. The female typically lays 3 eggs in a cup nest suspended from the outer branches of a tree, at a height of 3 to 9 m. Pairs will usually re-nest if a nest fails and will sometimes nest again after having a successful nest.

Nest predation is the most common cause of nest failure. Brown-headed Cowbirds will occasionally lay eggs in Acadian Flycatcher nests and these parasitized nests rarely produce any young flycatchers. Nests located near forest edges, roads, or urban development are generally less successful and produce fewer young than nests located in higher-quality habitats, such as in the interior of a large mature forest more than 600 m from the nearest edge. Such ideal habitat conditions are rare within the agriculture-dominated landscape of southern Ontario.

Population sizes and trends

The Canadian population is estimated to be 25 to 75 breeding pairs, or 60 to 180 adults, including polygynous birds. Regular surveys since 1997 indicate that the population in southern Ontario has been relatively stable, although there has been considerable variation in which sites are occupied or have multiple pairs. Less than half of the known breeding sites are occupied in any given year, and most sites are occupied only sporadically. Even sites that have supported multiple pairs in some years show a pattern of intermittent occupancy. Recolonization of sites is common, provided that habitat remains suitable.

Threats and limiting factors

The Acadian Flycatcher population in Canada is very small and annually occurs at no more than about 20 sites scattered across a relatively large area (35,000 km^2). The productivity of the population in southern Ontario is adversely affected by degraded habitat conditions, particularly low regional forest cover and high forest fragmentation. Productivity may not be sufficient to maintain the Canadian population, and its survival here may be quite dependent on immigration from the large Acadian Flycatcher population in the United States, particularly from Great Lake states bordering southern Ontario. Although large, fairly stable populations occur in the United States, there is recent concern that populations in the northeast will experience substantial declines resulting from the loss of preferred nest tree species (especially Eastern Hemlock, American Beech and Eastern Flowering Dogwood) owing to recent outbreaks of invasive insects and epidemics of forest pathogens.

Special significance

The Canadian breeding range of the Acadian Flycatcher is largely restricted to the Carolinian Region of southern Ontario. Its breeding habitat in Canada is important to many other species at risk. The Acadian Flycatcher is often used as a focal species for forest bird research in eastern North America because it is considered relatively easy to study, and is an indicator of forest habitat conditions at a range of scales.

Existing protection, status, and ranks

COSEWIC assessed this species as Endangered in November 2000. This species and its residence are protected under the federal *Migratory Birds Convention Act*. This species is also presently listed as Endangered, Schedule 1 under the federal *Species at Risk Act* and the Ontario *Endangered Species Act 2007*. Provisions for habitat protection under these Acts do not presently apply to Acadian Flycatcher.

TECHNICAL SUMMARY

Empidonax virescens
Acadian Flycatcher — Moucherolle vert
Range of Occurrence in Canada: Ontario

Demographic Information

Generation time (average age of parents in the population) *Average age of breeding adults is likely 2-3 years as for other small birds. This estimate is supported by the available colour banding data from Ontario.*	2-3 yrs
Is there an observed continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations	Stable
Observed percent change in total number of mature individuals over the last 10 years, or 3 generations.	Stable
Projected or suspected percent change in total number of mature individuals over the next 10 years, or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent change in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Not applicable
Are there extreme fluctuations in number of mature individuals? *Numbers naturally fluctuate year to year by as much as 50%*	Variable, but not extreme

Extent and Occupancy Information

Estimated extent of occurrence *Calculation is based on the range envelope polygon described by occurrences reported during the second Ontario Breeding Bird Atlas data (2001-05) excluding a single outlying record of a singing male in suitable habitat observed on one day only. Areas of water within the polygon were excluded.*	36,500 km²
Index of area of occupancy (IAO) *Based upon a maximum of 50 occupied sites/year and using a 2 x 2 km grid overlay.*	≤200 km²
Is the total population severely fragmented? *Sites are scattered but dispersal between sites is expected.*	No
Number of "locations" *Insufficient information available to estimate number of locations in relation to threats*	Unknown
Is there an observed, inferred, or projected continuing decline in extent of occurrence? *Increase from an EO of 18,500 km² using data from the first Ontario Breeding Bird Atlas (1981-85) in part due to directed searches during second Atlas, but could also signal a possible range expansion north of the Carolinian region.*	No; stable or possibly increasing
Is there an observed continuing decline in index of area of occupancy?	No
Is there an observed, inferred, or projected continuing decline in number of populations?	Not applicable
Is there an observed, inferred, or projected continuing decline in number of locations?	Not applicable

Is there an observed, inferred, or projected continuing decline in area, extent and/or quality of habitat? *Amount of habitat within southern Ontario estimated by Recovery Team members as variable, with habitat losses in some parts partly offset by slow increase in forest cover in other areas. Habitat quality has declined at some sites over the past 10 years, and is anticipated to deteriorate further with the projected spread of invasive forest insects and tree pathogens.*	Variable, but projected to decline
Are there extreme fluctuations in number of populations? *Single population*	Not applicable
Are there extreme fluctuations in number of locations?	Not applicable
Are there extreme fluctuations in extent of occurrence? *Site occupancy within this EO is intermittent but the overall size of the total EO does not appear to vary markedly from year to year.*	Variable, but not extreme
Are there extreme fluctuations in index of area of occupancy?	Variable, but not extreme

Number of Mature Individuals (in each population)

Population	**N Mature Individuals**
Extrapolated from counts of territorial and paired males during directed searches of known and potential habitat in southern Ontario conducted in 2007. See text.	Est. 50 (25-75) pairs or 112 (60-180) adults
Total	Est. 50 (25-75) pairs or 112 (60-180) adults

Quantitative Analysis

*Preliminary quantitative analysis (Tischendorf 2003; see **Fluctuations and Trends**).*	Persistence in Canada apparently reliant upon immigration from U.S.

Threats (actual or imminent, to populations or habitats)

- Small population in Canada.
- Loss/degradation of mature forest cover.
- Loss of preferred nest tree species (hemlock, beech, flowering dogwood) owing to invasive forest insect pests and pathogens.
- Reduced productivity due to degraded habitat conditions (especially due to low regional forest cover, and high fragmentation) on the breeding grounds.

Rescue Effect (immigration from outside Canada)

Status of outside population(s): Global population of 4.7 million individuals breeding in eastern United States. Population is generally secure across most of U.S. range. Range expansion in U.S. Northeast and population increases in some states adjacent to Ontario population are projected to be counter-balanced by loss of favoured nest tree species owing to the recent spread of invasive forest insects and tree pathogens.	
Is immigration known or possible?	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Yes

Current Status

COSEWIC: Endangered (April 2010)
Ontario: Endangered

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	D1

Reasons for designation:
In Canada, this species is restricted to certain types of mature forest in southern Ontario. Only small numbers breed in Canada. Although the population appears to have been relatively stable over the past 10-20 years, this is most likely due to immigration from U.S. populations. The species is threatened by forestry practices, particularly those that target removal of large trees. Serious conservation concerns, both in Canada and the adjacent U.S. also stem from increasingly widespread losses of a variety of favoured nest tree species owing to the spread of an array of invasive forest insects and pathogens. Collectively, these threats to habitat greatly reduce potential for rescue from adjacent U.S. populations.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criterion. EO is >20,000 km². IAO is <500 km², but there is no evidence for decline, fragmentation or extreme fluctuation in populations, habitat or range.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion. Population size is <2500 mature individuals but there is no evidence for decline or extreme fluctuation in numbers.
Criterion D (Very Small Population or Restricted Distribution): Meets Endangered D1; population size (60-180 adults) is <250 mature individuals
Criterion E (Quantitative Analysis): Preliminary analysis suggests that persistence of the Canadian population relies on regular immigration of at least small numbers of breeding adults from the adjacent states.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2010)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Acadian Flycatcher

Empidonax virescens

in Canada

2010

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WILDLIFE SPECIES INFORMATION AND SIGNIFICANCE

Name and classification

Scientific name: *Empidonax virescens*
English name: Acadian Flycatcher
French name: Moucherolle vert

This monotypic species, first described in 1810, is one of 15 species in the genus *Empidonax* in the New World tyrant flycatcher (Tyrannidae) family (Whitehead and Taylor 2002; Clements 2008).

Morphological description

The Acadian Flycatcher is a small, drab songbird (body length: 15 cm; body mass: 12 to 14 g) with olive-green upperparts, a whitish to yellowish eye ring, a relatively heavy bill with a mostly pale lower mandible, dark wings with two white to buffy wing bars, a pale white throat, a faint olive breast band, and pale underparts typically with a yellow wash to the belly and undertail coverts (Whitehead and Taylor 2002). It is very similar in appearance to other *Empidonax* flycatchers, and during the breeding season is best distinguished by its distinctive *peet-sa* song, other characteristic vocalizations, and habitat.

In the hand, this species can be distinguished from other *Empidonax* species by a combination of features including size (wing chord 65-80 mm), bill shape and colour, grey legs, and an especially long primary projection (Pyle 1997). Juvenal, Basic, and Alternate plumages are all similar but, on close examination, subtle differences in plumage can often be used to distinguish young birds through to the end of their first breeding season (Pyle 1997).

Plumages of both sexes are similar but males are significantly larger than females and the combination of wing chord and tail length measurements can be used to discriminate between the sexes (Wilson 1999). During the breeding season, males develop a distinct cloacal protuberance and breeding females have a well-defined brood patch (Pyle 1997; Wilson 1999; Whitehead and Taylor 2002).

Spatial population structure

There is currently no evidence of spatial population structuring within the Canadian or North American population of this species. No subspecies are recognized and no geographic variation is known (Pyle 1997; Whitehead and Taylor 2002). Measures of intra-specific genetic variation (n=10) are typical of other bird and vertebrate species (Zink and Johnson 1984). Feather and blood samples collected in 2003 from Acadian Flycatchers breeding in Canada and the Great Lakes states have not yet been analyzed (Woolfenden and Stutchbury 2003; Stutchbury, pers. comm. 2008).

The small Canadian population is contiguous with much larger populations in adjacent parts of the United States including New York, Pennsylvania, Ohio and Michigan. Lake Erie does not pose a significant geographic barrier to this long-distance migratory species.

Despite its similar appearance, the genetic signature of the Acadian Flycatcher is strongly differentiated from other *Empidonax* species and it is considered a separate single-species clade within this taxon (Zink and Johnson 1984; Johnson and Cicero 2002).

Designatable units

All Acadian Flycatchers breeding in Canada are within a single geographic region. Hence, one designatable unit is considered in this report.

Special significance

The Acadian Flycatcher is part of a suite of eastern North American forest birds the Canadian breeding range of which is largely restricted to the Carolinian region of southern Ontario (Deschamps and McCracken 1998). Other members of this suite that are presently identified as species at risk in Canada include Prothonotary Warbler (*Protonotaria citrea*; Endangered), Hooded Warbler (*Wilsonia citrina*; Threatened), Cerulean Warbler (*Dendroica cerulea*; Special Concern), and Louisiana Waterthrush (*Seiurus motacilla*; Special Concern). Numerous other species at risk and rare wildlife species are also associated with Carolinian woodlands and the Carolinian region has among the highest levels of biodiversity in Canada (Carolinian Canada 2008; Jalava *et al.* 2008). Consequently, Acadian Flycatcher breeding habitat is also vitally important to many other Canadian species at risk.

This species is also part of a suite of Neotropical migrant forest songbirds that has been the subject of extensive studies in the northeastern United States and southeastern Canada in connection with the impact of silvicultural practices, and landscape-, patch- and site-scale forest metrics on reproductive success and population dynamics (Whitehead and Taylor 2002; Woolfenden *et al.* 2005; Bakerman and Rodewald 2006; Hoover *et al.* 2006; Rodewald and Shustack 2008). This species is considered a focal species because it is relatively easy to study and because it is considered a sensitive indicator of habitat conditions at a range of scales.

No Aboriginal Traditional Knowledge is currently available for this species.

DISTRIBUTION

Global range

The Acadian Flycatcher is a medium- to long-distance neotropical migrant. It breeds in eastern North America, and winters in Central America and northwestern South America (Figure 1). The total global breeding range (extent of occurrence) is approximately 2,400,000 km^2, while the total global wintering range is approximately 700,000 km^2 (derived from Ridgeley *et al.* 2007).

The breeding range of this species corresponds closely to the Eastern Avifaunal Biome, being widely distributed in forested landscapes east of the Great Plains (Rich *et al.* 2004). The northern range limit extends from southeast Minnesota, across southern Wisconsin, southern Michigan, southwestern Ontario, and western and southeastern New York (Whitehead and Taylor 2002).

The Acadian Flycatcher's global breeding distribution is presumed to have retracted in the 1800s in response to the extensive deforestation of eastern North America (Martin 2007). Further range contraction occurred in the northeast United States during the 1900s. This was followed by a trend of reoccupation of its former range starting in the 1960s, likely facilitated by maturation of second-growth forests in the northeastern United States (Whitehead and Taylor 2002). Breeding season records from northern New England since the 1980s indicate an expansion of the historic breeding range in the northeastern United States (Whitehead and Taylor 2002).

The wintering range of the Acadian Flycatcher extends from the Caribbean slope of Nicaragua, south through Costa Rica, Panama, northern and western Columbia, northwestern Venezuela and western Ecuador (Whitehead and Taylor 2002; see Figure 1). The greatest winter concentration may occur from Panama and farther south (Fitzpatrick 1978 in Whitehead and Taylor 2002).

Canadian range

The Acadian Flycatcher's Canadian breeding range is restricted to southern Ontario, where it is considered a rare local breeder (Figures 2 and 3; Godfrey 1986; Woodliffe 1987; James 1991; Austen *et al.* 1994; Martin 2007). Most Canadian breeding records fall within the Carolinian biogeographic region, which is generally equivalent to the provincial Lake Erie-Lake Ontario and the federal Lake Erie Lowland ecoregions. Some records occur in adjacent parts of the Lake Simcoe-Rideau ecoregion (Figure 3). The current Canadian distribution represents approximately 1% of the total global breeding range.

The Acadian Flycatcher's historic distribution in Ontario is not well known, because this species is fairly inconspicuous, difficult to identify, and nests in forested tracts that are seldom visited during the breeding season (Woodliffe 1987). There is no information on its distribution in Ontario prior to the late 1800s, by which time the landscape of southern Ontario had been radically altered by the conversion of the extensive woodlands and wetlands to agricultural cropland and pasture (Austen *et al.* 1994; Larson *et al.* 1999). The first nesting records for Canada date from 1884 and 1910 (Saunders 1909, 1910).

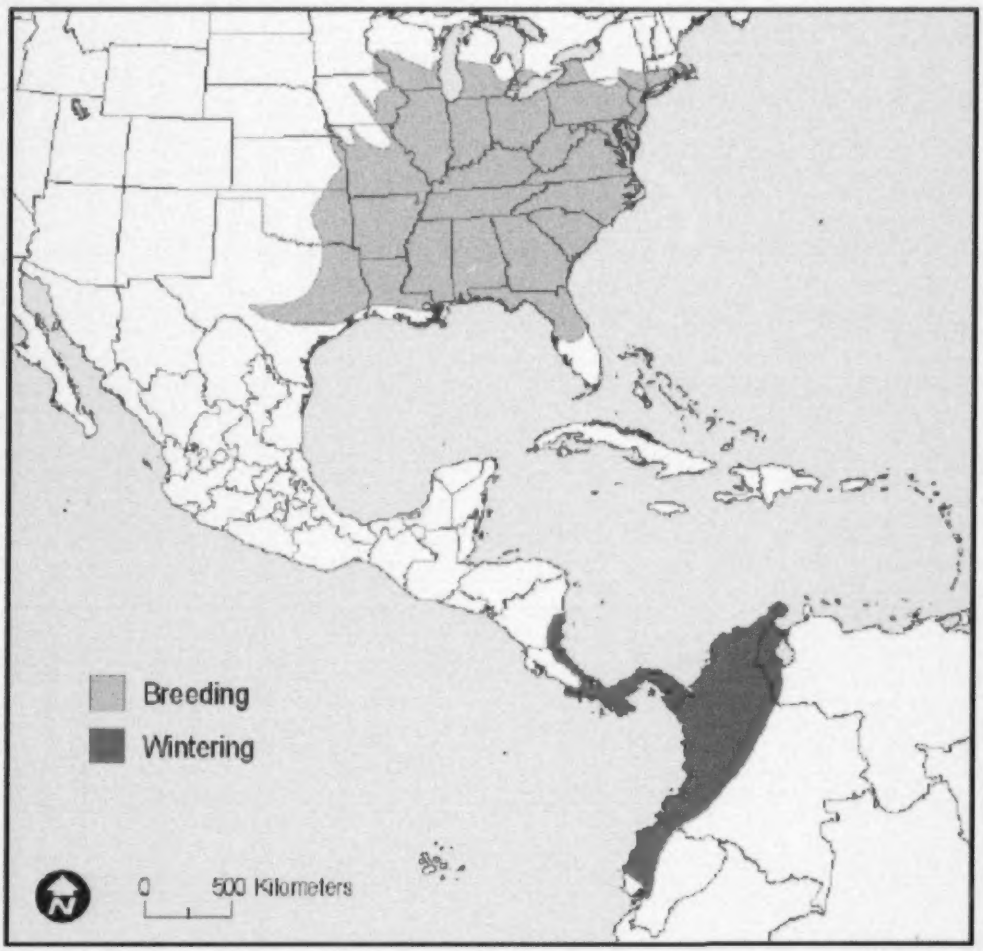

Figure 1. Breeding and wintering distribution of the Acadian Flycatcher (from Ridgeley *et al.* 2007).

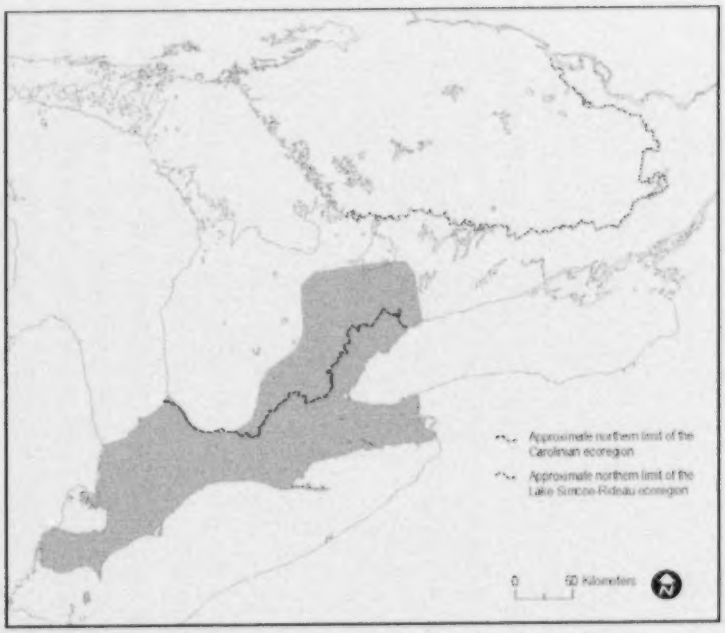
Approximate northern limit of the Carolinian ecoregion
Approximate northern limit of the Lake Simcoe-Rideau ecoregion
0
50 Kilometers

Figure 2. Breeding distribution of the Acadian Flycatcher in Ontario, showing overall extent of occurrence (adapted from Cadman *et al.* 2007). Within this broad zone, the species is highly localized, and occupies fewer than 50 sites in any given year (see Figure 3 below).

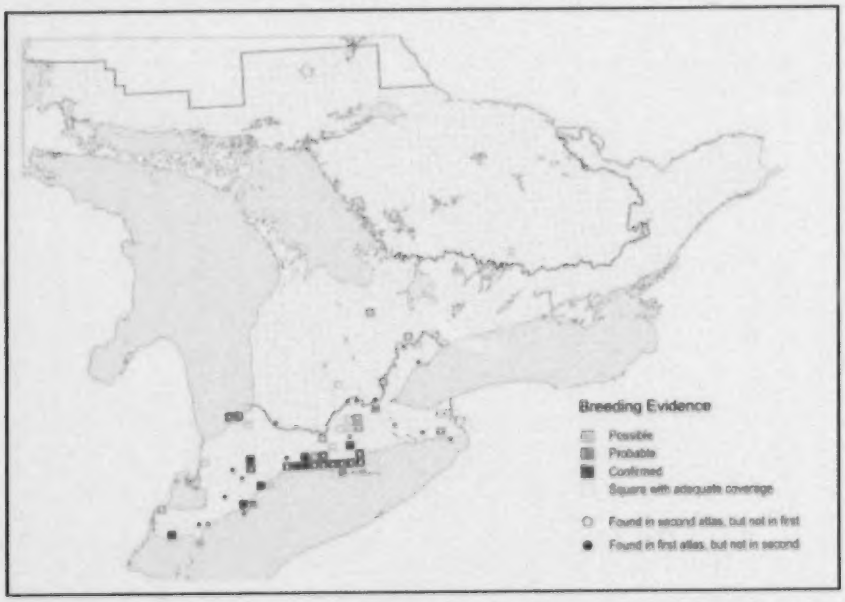

Figure 3. Breeding bird atlas detailed distribution of the Acadian Flycatcher in Ontario from 2001-05 (from Cadman *et al.* 2007).

Prior to the 1970s, this species was considered a rare but fairly regular local breeder along the north shore of Lake Erie (Speirs 1985; Godfrey 1986; Woodliffe 1987; Austen *et al.* 1994). In the 1980s, several new breeding locations were discovered scattered throughout the Carolinian region, likely the result of increased coverage during the first breeding bird atlas (Speirs 1985; Woodliffe 1987; James 1991; Austen *et al.* 1994). Since 1997, many additional Acadian Flycatcher breeding locations have been identified, mostly as a result of directed searches coordinated by the Acadian Flycatcher/Hooded Warbler Recovery Team (see **Sampling Effort** for further details).

The distribution map presented in the most recent Ontario breeding bird atlas is considered representative of the Acadian Flycatcher's actual distribution in 2001-05 (Martin 2007; see Figure 3). The atlas map suggests a northward range expansion beyond the Carolinian region over the 20-year interval between atlases (Martin 2007), but the degree to which this is true is complicated by a concurrent increase in search effort and a general improvement in observer skills.

The current extent of occurrence (EO) of the Acadian Flycatcher in Canada, as delineated by the range envelope polygon described by occurrences reported during the 2001-2005 Atlas project (Figure 2), is approximately 36,500 km^2. This figure is about double the EO of 18,500 km^2 calculated using occurrence data from the 1981-85 atlas, but again the extent to which this reflects an actual range expansion is unknown.

Between 1997 and 2007, Acadian Flycatchers were recorded at 60 sites. The index of area of occupancy (IAO) is estimated to be ≤200 km^2 if a maximum of 50 sites is assumed to be occupied in any given year, and based on a 2 x 2 km grid overlay.

Non-breeding

This species is rarely encountered during migration in Ontario (James 1991), at least in part because it is easily confused with more common congeners. Vagrants have occurred in Quebec and British Columbia (Godfrey 1986; Gauthier and Aubry 1996). Most non-breeding records are of spring migrants at birding hotspots and bird banding stations along the shores of Lakes Erie, Huron, and Ontario. Fall migration records of this species are extremely rare.

On the Lake Erie shoreline, it is considered a regular but rare spring migrant at Point Pelee (ca. 1 bird per year; Huebert 2007; V. MacKay pers. comm. 2008). At Long Point, it is an irregular rare spring migrant, with a maximum of 8 individuals banded in a year (Long Point Bird Observatory unpubl. records 1960-2008). It was considered a fairly regular but rare spring migrant at Prince Edward Point (Lake Ontario), with several records between 1976 and 1986 (Weir 1989); however, this species has not been reported there in recent years (Prince Edward Point Bird Observatory unpublished records 2001-2008). A pilot banding station at Pinery Provincial Park on the southeast shore of Lake Huron captured five birds in spring 2007 (Ausable Bird Observatory unpubl. records 2006-07).

In Ontario, many June records of single singing males present in suitable (or marginal) habitat for one or a few days appear to be late migrants or wandering individuals that have overshot or not yet reached their breeding grounds. Some of the atlas records with possible breeding evidence likely represent late migrants or prospecting birds.

HABITAT

Habitat requirements

Breeding Habitat

The Acadian Flycatcher nests in mature, closed-canopy forest habitats. Within a physiographic region, this species exhibits a high degree of habitat specificity at various scales (Bakerman and Rodewald 2006). Across the breeding range, there are geographic differences in the specific habitats selected and in its response to landscape characteristics.

In Ontario and elsewhere, it is found primarily in deciduous and mixed forests (Whitehead and Taylor 2002; Martin 2007). Acadian Flycatcher territories in Ontario are typically in either mature tableland forests or forested ravines (Bisson *et al.* 2000; Friesen *et al.* 2000; Martin 2007). Sites known to be occupied (1985-2004)) are about evenly divided between these two settings (Recovery Team unpubl. data). Although there is no quantitative estimate of the relative amount of suitable habitat available in ravine versus tableland settings in southern Ontario, it appears that ravine settings are favoured by Acadian Flycatchers here, perhaps because these sites are less likely to be exposed to intensive logging practices and hence have relatively undisturbed older-growth features.

Within both tableland and ravine settings, territories are associated with areas of tall mature trees, high overstorey canopy cover, an open understorey, and high basal area. In tableland forests, nests are often situated over vernal pools, trails or patches with little or no ground cover. In ravine settings, nests are located near (often over) a stream. Nearby areas with a more open canopy and higher regeneration cover are important during the critical post-fledging period (Burke 2007a).

In ravine and riparian settings in Ontario and the northeastern U.S., this species shows a strong preference for sites with an Eastern Hemlock (*Tsuga canadensis*) component (Martin 2007; Becker *et al.* 2008). In tableland settings, it nests in mature upland beech-maple woods and lowland soft maple swamps, often at the interface of wetland and upland knolls (Martin 2007; D. Sutherland pers. comm. 2009).

Nests in Ontario and elsewhere are situated 3 to 9 m high in small trees, saplings and shrubs (Friesen *et al.* 2000; Whitehead and Taylor 2002; ONRS 2008). Over the entire historical record, the most frequent nest-support species in Ontario (*n*=186) are American Beech (*Fagus grandifolia*; 35%), Witch-hazel (*Hamamelis virginiana*; 16%), Sugar Maple (*Acer saccharum*; 13%), Eastern Hemlock (11%), and Eastern Flowering Dogwood (*Cornus florida*; 9%; ONRS 2008). The above percentage figures do not necessarily represent the actual relative importance of individual tree species, because the high use of species like hemlock and flowering dogwood was only recently discovered during special search efforts by the Recovery Team in the last decade or so. Regardless, nests are nearly always suspended from the forks of lateral branches that extend more or less horizontally from the trunk; this particular growth form is a key feature of all the aforementioned species favoured by nesting Acadian Flycatchers (J. McCracken pers. comm. 2009)

The Acadian Flycatcher has been characterized as an area-sensitive species (e.g., Robbins *et al.* 1989). However, a more recent meta-analysis of area and edge effects found that its occurrence is consistent with edge-avoidance and that it does not show significant patch-size effects (Parker *et al.* 2005). Edge-avoidance seems to be less of a factor in forested ravine situations because it will nest in long linear territories that occur in quite narrow (minimum of 80-85 m) belts of riparian forest corridors (Friesen *et al.* 2000; Bakerman and Rodewald 2006; Chapas-Vargas and Robinson 2007).

Studies of Acadian Flycatcher occurrence and breeding success in the United States have shown that it is sensitive to site-, patch- and landscape-scale effects. At least in some settings, this species is negatively impacted by openings in the forest canopy (e.g., due to selective logging or tree mortality caused by invasive pests), anthropogenic edges, increasing forest fragmentation, and urbanization (Whitehead and Taylor 2002; Bakerman and Rodewald 2006; Hetzel and Leberg 2006; Hoover *et al.* 2006; Becker *et al.* 2008; Rodewald and Shustack 2008; Rodewald 2009). However, the response to these factors is not always consistent across the breeding range, possibly because these effects can be masked by other landscape-level effects such as elevated predator and brood parasite populations (Robinson and Robinson 1999; Bell and Whitmore 2000; Hazler *et al.* 2006; Chapas-Vargas and Robinson 2006; Chapas-Vargas and Robinson 2007).

Preliminary coarse-scale habitat modelling exercises based on landcover data suggested that the amount of potential habitat for Acadian Flycatchers in southern Ontario may be as much as two orders of magnitude greater than the present area of occupancy (Flaxman 2004). However, this is almost certainly a gross overestimate, because coarse-scale habitat modelling does not sufficiently capture the fine-scale habitat features that are required by this species (J. McCracken pers. comm. 2009).

Wintering Habitat

The Acadian Flycatcher winters in a range of lowland and pre-montane forest habitats in Central and South America, including the understorey of humid forest, second-growth woodlands, forest edges, and shrub thickets (Whitehead and Taylor 2002; NatureServe 2008). Little is known about wintering habitat requirements (NatureServe 2008).

Migration Habitat

During migration this species is found in a broad range of woodland habitats, including open young forests, forest edges and urban woodlands, as well as primary and secondary forests (Whitehead and Taylor 2002; NatureServe 2008).

Habitat trends

Breeding Habitat

In the absence of forest resource inventory (FRI) mapping for southern Ontario, it is difficult to quantify the amount and quality of Acadian Flycatcher habitat in Canada or to assess recent trends. In particular, current microhabitat (site and stand)-level information on forest age, canopy closure, and forest structure is not available (OMNR 2006). The best available information on the extent of forest cover for this region is Ontario Land Cover mapping, which uses classified Landsat 7 satellite imagery collected between 1999 and 2002 (OMNR 2006). However, such coarse-scale information again does not capture the Acadian Flycatcher's specific habitat requirements.

Long-term changes in the extent and distribution of woodlands in southern Ontario have been described by Larson *et al.* (1999), who examined various existing data sets covering the area south and east of the Canadian Shield (generally equivalent to the Carolinian and Lake Simcoe-Rideau regions combined). Since 1700, the landscape of southern Ontario has undergone radical changes, from a predominantly forested landscape prior to European settlement, to almost completely deforested by 1900 due to the removal of the forests by early settlers (Larson *et al.* 1999). The low point for forest cover in southern Ontario occurred around 1920 at about 11% (Larson *et al.* 1999). Since 1920, there have been further losses in the amount of original forest that has never been cleared but this has been offset by a dramatic increase in second-growth replacement forests on abandoned agricultural land (Larson *et al.* 1999). By 1986, total forest cover in southern Ontario had increased to about 19%, but most of this consisted of second-growth replacement forests and the extent of original forest had declined to only 5.8% of total land cover (Larson *et al.* 1999).

Most of the increase in forest cover in southern Ontario over the 20th century was in the Lake Simcoe – Rideau region. Forest cover in all parts of the Carolinian region remains well below the 30% threshold considered necessary to maintain forest bird diversity (OMNR 2000; Environment Canada 2004). Essex and Chatham-Kent counties in the extreme southern Carolinian region have less than 5% forest cover (Larson *et al.* 1999).

Forest configuration is also a concern because Acadian Flycatchers are sensitive to forest fragmentation effects. The forests within the Canadian breeding range of this species are highly fragmented, with two-thirds of all forest patches being less than 5 ha, and with only 431 patches being over 100 ha in size (Flaxman 2004). Due to high fragmentation, less than 2% of the Carolinian region consists of interior forest (>100 m from edge), and less than 0.5% is deep interior forest (>200 m from edge; Cadman 1999). For the Acadian Flycatcher, edge-effects on productivity can extend as much as 600 m into the forest, as reported by one study in Illinois (Hoover *et al.* 2006). There are few forest patches within the Canadian Acadian Flycatcher EO that include areas more than 600 m from the nearest edge. That said, in Ontario, this species appears to do well in long, linear, forested ravine situations that may be no more than 100-200 m in width.

In the absence of comparable quantitative data sets, recent trends in the amount of forest and interior forest within the Canadian breeding range of the Acadian Flycatcher are difficult to assess. Strategic habitat restoration efforts are underway to enhance forest-interior habitat in several of the core forest complexes in the Carolinian region, and to re-forest riparian corridors generally in southern Ontario. However, it takes many decades before re-forested (or heavily harvested) areas attain sufficient maturity to be attractive to Acadian Flycatchers.

Repeat surveys of known Acadian Flycatcher sites indicate that over the past decade, habitat degradation is more pervasive and a more significant threat than outright loss of forest habitat, especially in tableland settings. Habitat quality for Acadian Flycatchers in some local areas of southern Ontario has benefited from improved planning regulations, new tree-cutting bylaws, the designation of heritage woodlands, and changes to forest silviculture practices. However, these improvements are not region-wide and likely haven't been sufficient to offset the detrimental impacts of the spread of invasive alien species, agricultural intensification, urban sprawl, and rural residential development.

Habitat in the eastern United States is much more extensive than in Ontario, including large areas of high forest cover in the core part of the species' breeding range. Forest regeneration over the past century has also been more extensive in the northeastern United States than in southern Ontario. Even so, forest fragmentation and urbanization are adversely affecting habitat quality in many parts of this species' breeding range, including the Great Lakes states bordering Ontario.

Wintering and migration habitat

Information on trends in wintering and migration habitat is not available. Outside of the breeding season, this species uses a broad range of habitats, but deforestation on the wintering grounds is a potential concern (Whitehead and Taylor 2002).

BIOLOGY

The breeding biology of the Acadian Flycatcher has been studied intensively in the United States. Since 1997, the small, localized population in Canada has been the focus of extensive surveys and intensive studies carried out under the direction of the national Acadian Flycatcher/Hooded Warbler Recovery Team. Available information on the Canadian population gleaned from Recovery Team reports and databases is summarized in this section, supplemented with relevant information from studies in the U.S. Relatively little is known about the biology of this species on migration or on its wintering grounds (Whitehead and Taylor 2002).

Life cycle and reproduction

The Acadian Flycatcher's life cycle is fairly typical of other small passerines; most information below is summarized from Whitehead and Taylor (2002). Both sexes breed at one year of age. Clutch size is generally 3 eggs and ranges from 1 to 4. Mean clutch size for Acadian Flycatcher nests in Ontario is 2.9 ± 0.4 (range 1-4, n=104), which is similar to elsewhere (ONRS 2008). Second clutches are generally smaller than first clutches. The incubation period is about 14 days; incubation and brooding is by the female only. Nestlings and fledglings are fed by both adults. Fledglings are fed by both parents for at least 14 days and remain in the vicinity of the nest for up to 21 days.

The Acadian Flycatcher is mostly socially monogamous, but there are many documented instances of polygyny (Whitehead and Taylor 2002). Polygyny rates in Ontario are variable (e.g., 7 of 29 males in 2002-03, 3 of 16 territorial males in 2007) and appear to be higher than elsewhere (e.g., 3 in 135 territories in Pennsylvania; Woolfenden and Stutchbury 2004a,b; Woolfenden *et al.* 2005).

Territorial males sing frequently throughout the breeding season; females also sing on occasion (Whitehead and Taylor 2002). Both sexes frequently call to each other. In addition to the distinctive *peet-sa* territorial song, males and females have other characteristic vocalizations that can provide clues as to breeding status and nest locations.

The size of breeding territories in Ontario averaged 2.7 ha (n=10, range 0.76 to 4.09 ha) and 1.94 ha (n=20, range 0.94 to 3.09 ha) in 2006 and 2007, respectively (Burke 2006, 2007b). This is much larger than average territory sizes reported in the core U.S. range (e.g., 1 ha in Ohio and Pennsylvania; Whitehead and Taylor 2002; Woolfenden *et al.* 2005; Rodewald and Shustack 2008), where densities of breeding birds are much greater. Breeding territories may also be largest in dry upland areas and in drought years (Whitehead and Taylor 2002).

Although previously considered a solitary species, high rates of extra-pair fertilizations were documented in Pennsylvania, with most extra-pair fertilizations involving males that had forayed a kilometre or more from their territory rather than the males in neighbouring territories (Woolfenden *et al.* 2005). The home range of breeding males is therefore considerably larger than the territory size. The opportunity for extra-pair copulations and conspecific social interactions may influence the selection of breeding sites (Woolfenden *et al.* 2005).

Annual re-use of particular breeding sites in Ontario is often intermittent or sporadic; hence,"traditional" Acadian Flycatcher sites here show a pattern of intermittent occupancy (Martin 2007; Recovery Team unpubl. data). Owing to the turnover of small numbers of site-faithful adults, sites containing suitable habitat may be occupied by one or more pairs for several consecutive years, then fall unoccupied for a short period, only to be re-colonized again a few years later. Provided that breeding habitat remains suitable, many sites in Ontario show this kind of repeating pattern over several decades. Moreover, there are many cases of "new" birds essentially re-colonizing the same territorial space held by their deceased predecessors, demonstrating the highly specific habitat needs of this species. In contrast, owing to high population densities, individual territories in Pennsylvania tend to be occupied perennially despite turnover in breeding individuals (Woolfenden *et al.* 2005). In Ohio, riparian sites with high urbanization (and lower seasonal productivity) have higher rates of turnover in occupancy than more rural sites (Rodewald and Shustack 2008).

The proportion of unpaired birds in the Ontario population is difficult to determine, with estimates ranging from 10% to 50%. The higher figure is based on the number of singing males reported during extensive surveys (e.g., 19 of 36 males in the 2007 survey), which include males that were found only on a single visit. The lower figure is based on the number of unmated males reported from intensive surveys at core sites that traditionally support multiple birds (e.g., 3 of 29 males in 2002-03), and is an underestimate because it does not include unmated birds in marginal habitats at other sites. The lower figure is comparable to the 12 of 135 territories held by single males in a Pennsylvania study (Woofenden *et al.* 2005).

Nest success rates in the species are highly variable from region to region and year to year. Data from Ontario show strong year-to-year variation in the proportion of successful nests, ranging from 33% to 73% (Table 1). Success rates from as low as 10 to 25%, to as high as 65% have been reported in U.S. studies (Whitehead and Taylor 2002).

No estimates of lifetime reproductive success are available (Whitehead and Taylor 2002). The 95 nesting attempts tracked in Ontario for the 2001-2004 period fledged an average of 1.7 young per female per year (Table 1). This rate is similar to the annual reproductive productivity of about 1.6 fledged young per pair (n=193, range 0 to 7 young per pair per season) over a 6-year study in Ohio but about half the seasonal fecundity rate of 1.8 female fledglings per adult female (n=30) per season reported in a study in an extensively forested area in Virginia (Fauth and Cabe 2005; Rodewald and Shustack 2008). The latter rate may represent ideal conditions, because no cowbird parasitism occurred, nest predation rates (41%) were moderate, and all females re-nested at least once (Fauth and Cabe 2005). The Ohio study covered a rural-urban gradient and found that productivity was significantly lower in more urbanized areas (Rodewald and Shustack 2008; Rodewald 2009).

The longevity record for this species (based on banding records) is a female that was at least 12 years, 1 month old (Twedt 2008). As with other small passerines, the expected life span is short, and the generation time (average age of breeding adults) is likely 2-3 years. This estimate is supported by data on banded adults returning to their previous year's breeding site. Return rates for the Ontario population (small sample size) are highly variable: males 58% in 2003, 25% in 2004; and females 71% in 2003, 6% in 2004 (Woolfenden and Stutchbury 2004b). Return rates of breeding birds in the US range from 18% (n=234) in fragmented forests in Indiana, to 45% (n=31) in forest fragments in Michigan, and 52% (n=52) in continuous forest in Virginia (Walkinshaw 1966; Whitehead and Taylor 2002; Fauth and Cabe 2005). Females appear to have lower return rates than males (Walkinshaw 1966; Rodewald and Shustack 2008).

One analysis from Ohio reported apparent annual survival of males of 0.53 +/- 0.056 SE, versus females of 0.23 +/- 0.064 SE (Rodewald and Shustack 2008). Detection probability in this study was fairly high, 0.73 +/- 0.088 for males, and 1.0 +/- 0 for females.

Predation

Predation is the main cause of nest failure in Ontario (Table 1) and elsewhere. There are few direct observations of nest predation events but likely nest predators in southern Ontario include other bird species (Blue Jay, *Cyanocitta cristata*, and forest raptors), small mammals (squirrels, chipmunks, and mice), and arboreal snakes (Gray Ratsnake, *Pantherophis spiloides*, and Eastern Foxsnake, *P. gloydi*; Whitehead and Taylor 2002). Information on predation of fledged young and adults is not available.

Diet and foraging behaviour

The Acadian Flycatcher feeds mostly on insects and insect larvae, with spiders and other arthropods also taken (Whitehead and Taylor 2002). Aerial foraging sallies are directed at food items gleaned on leaves in the understorey and lower canopy vegetation layers, from 2 to 12 m in height. It also regularly hawks flying insects. Important food items include wasps, bees, ants, moths, beetles, and flies (Whitehead and Taylor 2002).

Table 1. Nest productivity statistics for Acadian Flycatcher nests in southern Ontario, 2001-04 (Martin 2001; Woolfenden and Stutchbury 2004a,b).

Year	2001	2002	2003	2004	Total
Number of females	9	10	22	18	59
Number of nest attempts	15	18	39	23	95
Number of double brooding attempts	2	0	4	0	6
Number of successful double broods	2	0	1+	0	3+
Brood parasitism rate	6%	18%	3%	21%	8%
Nest predation rate	7%	50%	54%	33%	41%
Nest abandonment rate	20%	17%	3%	8%	9%
Nest success rate	73%	33%	33%	42%	41%
Clutch size	2.9	2.5	2.9	2.7	2.7
Number of host young fledged	26	18	35	23	102
Number of cowbird young fledged	(1 egg removed)	0	0	1	1

Physiology

No information is available on nutrition, energetics, metabolism, or temperature regulation (Whitehead and Taylor 2002). The Canadian population is at the northern limit of the species' breeding range, the edge of which is presumably limited by climatic tolerances because apparently suitable forest habitat is extensive farther north outside the current breeding range (Deschamps and McCracken 1998). Climate change could potentially expand the bioclimatic limit of this species to include areas of extensive woodlands in the Southern Shield region of southern Ontario (Martin 2007). Likewise, the future breeding distribution and abundance of this species in the northeastern United States is predicted to increase under various climate change scenarios due to a northward shift in habitat features (Matthews *et al.* 2004; Rodenhouse *et al.* 2008). However, habitat shift for species associated with mature forests, such as the Acadian Flycatcher, is predicted to occur relatively slowly (at least one century), due to the lag time associated with tree migration and longevity (Matthews *et al.* 2004).

Dispersal and migration

Site Fidelity

Individuals banded as breeding adults in southern Ontario and elsewhere show a high degree of site fidelity by both males and females, with returning birds often re-occupying the same territory (Whitehead and Taylor 2002; Recovery Team unpubl. data). Strong site fidelity has also been reported on the wintering grounds (Whitehead and Taylor 2002).

Dispersal

The paucity of inter-year encounters of individuals banded as nestlings suggests that young generally disperse to other sites to breed (dispersal distance unknown). The only record of an Ontario-banded nestling returning to breed was a male found breeding at its natal site (Woolfenden and Stutchbury 2004b).

Migration

The Acadian Flycatcher is a medium- to long-distance neotropical migrant. Males start to arrive in Ontario in mid-May (James 1991). Females generally arrive about a week later than males (Whitehead and Taylor 2002). Single-day occurrences of single birds observed in suitable habitat (and sometimes unsuitable habitat) in June are generally considered to be late migrants or wandering non-breeders. Fall departure dates are not well documented but, given their extended breeding period, Ontario birds likely begin their fall migration anytime from late July to early September.

None of the 156 Acadian Flycatchers banded during migration in Canada from 1955 to 1995 were encountered elsewhere, and no foreign banded birds were recovered in Canada during that period (Brewer *et al.* 2000). Since 1995 there have been a few Canadian band encounters, including a colour-marked individual captured during spring migration at Long Point that was originally banded the previous summer as a breeding adult at a traditional site about 10 km northwest of the banding station (Long Point Bird Observatory unpubl. data).

Little is known about the migratory behaviour of this species (Whitehead and Taylor 2002). No important migration concentration areas for this species are known in Canada or elsewhere.

Interspecific interactions

Acadian Flycatcher nests are parasitized by the Brown-headed Cowbird (*Molothrus ater*). Nests with a cowbird chick rarely fledge any Acadian Flycatcher young (Whitehead and Taylor 2002). Brood parasitism rates in Ontario are moderate, with 18 instances (13.5%, *n*=133; ONRS 2008). Parasitism rates in the US range are highly variable across landscapes, ranging from 0% in areas of continuous forest, to 3%-7% in areas with high forest cover, to 20%-50% in areas with less than 30% forest cover (Whitehead and Taylor 2002; Fauth and Cabe 2005; Hazler *et al*. 2006). Rates increase with increasing urbanization (Rodewald and Shustack 2008; Rodewald 2009).

Adaptability

The Acadian Flycatcher is a habitat specialist with specific breeding habitat requirements at various spatial scales (Bakerman and Rodewald 2006). The supply of mature, closed-canopy, open-understorey, interior-forest habitat is a limiting factor in many parts of its range, including southern Ontario. The reproductive success of this species is also affected by land use activities at various spatial scales, ranging from tree removal at the site level, to the amount of urbanization at the landscape level. This species may also be vulnerable to the spread of invasive alien plant species that alter forest structure by increasing understorey density and/or suppress the regeneration of native trees and shrubs (e.g., invasive honeysuckle shrubs, *Lonicera* spp., and Garlic Mustard, *Alliaria petiolata*).

This species does exhibit some degree of flexibility in that it can nest successfully in relatively narrow wooded ravine situations, and uses several different tree and shrub species for nest-support. Its ability to use different nest trees may be important because some of the preferred nest tree species (e.g., hemlock and beech) are being decimated by invasive forest pests (Hemlock Wooly Adelgid, *Adelges tsugae*, and beech bark disease, *Nectria gallingea*) in the northeastern United States, and similar tree mortality is expected to occur in southern Ontario within the next decade. The Acadian Flycatcher may also be relatively tolerant of predicted climate changes, because it is generally adapted to a warmer climate.

POPULATION SIZES AND TRENDS

Sampling effort and methods

Breeding Bird Survey

The North American Breeding Bird Survey (BBS) is a volunteer-based program designed to monitor trends in North American breeding bird populations. BBS routes consist of 50 roadside points along randomly selected, stratified routes throughout North America. Each point is surveyed once (3-minute point count) during the breeding season. The Acadian Flycatcher has rarely been detected on BBS routes in Canada. Although forest interior habitat is not well surveyed by BBS (Rich *et al.* 2004; Sauer *et al.* 2008), the overall Acadian Flycatcher population in North America appears to be reasonably well monitored by the BBS (detected on 973 routes situated throughout the US breeding range). BBS data have been used to calculate population estimates and population trends at various geographic scales (Rich *et al.* 2004; Blancher *et al.* 2007; PIF 2008; Sauer *et al.* 2008).

Forest Bird Monitoring Program

This species has been detected on a few Forest Bird Monitoring Program (FBMP) routes in Ontario (FBMP 2008). The FBMP is a volunteer-based program designed to complement the BBS. FBMP sites consist of three to six off-road point count stations situated in large mature forests in which little or no active forest management is underway. Each point is surveyed twice (10-minute point count) during the breeding season. Routes are not randomly situated.

Ontario Breeding Bird Atlases

The Canadian distribution of this species was mapped by the first and second Ontario Breeding Birds Atlas (OBBA1 and OBBA2) projects, carried out between 1981-85 and 2001-05, respectively (Cadman *et al.* 1987; Cadman *et al.* 2007). The Acadian Flycatcher was flagged as a rare species and atlassers were asked to provide detailed documentation. Almost all atlas squares (10 x 10 km) in the Carolinian and Lake Simcoe-Rideau atlas regions in southern Ontario received some coverage in both atlases and most received more than 20 hours of coverage. Total field effort in these regions increased moderately during OBBA2. The OBBA2 database and maps include the results of directed searches for Acadian Flycatcher (see below).

Special Surveys and Studies

Over the past 20 years there have been a series of coordinated efforts to survey and monitor populations of rare breeding birds in Ontario, including the Acadian Flycatcher. This species was one of a suite of rare birds included in the Ontario Rare Breeding Bird Program (ORBBP), the Ontario Birds at Risk (OBAR) program, and surveys of Carolinian forest birds (Austen *et al.* 1994; Deschamps and McCracken 1998). These programs involved monitoring occupancy at known sites and searching areas of suitable habitat using a combination of knowledgeable volunteers and experienced contract staff.

Since 1996, studies of the Acadian Flycatcher in Ontario have been coordinated by the Acadian Flycatcher/Hooded Warbler Recovery Team (Friesen *et al.* 2000). Coordinated surveys of known and potential Acadian Flycatcher breeding habitat in southern Ontario were carried out in 1997, 1998, 2002, and 2007 (Heagy *et al.* 1997; McCracken *et al.* 1998; Carson *et al.* 2003; and Heagy and Badzinski 2008). Most sites surveyed received only one visit, but follow-up visits were made to most sites where Acadian Flycatchers were detected on the first visit. Total survey effort in each of these coordinated surveys was similar, although there were differences in the sites covered. Due to ease of access and proximity to known sites, survey effort has been concentrated in the extensive public forests in Norfolk County, wooded ravines in Elgin County, and public lands within a few large forest complexes elsewhere in the Carolinian region.

Several core breeding locations have been monitored more frequently, with more intensive studies involving nest monitoring, colour banding, and territory mapping projects carried out in some years (Martin 2001, 2005; Woolfenden and Stutchbury 2004a,b; P. Burke 2006, 2007).

Most public forest lands within the Carolinian region have been surveyed at least once for Acadian Flycatcher by the recovery team over the past 12 years. However, many areas of potentially suitable habitat on private lands in the Carolinian region have never been searched. Search effort in forested areas north of the Carolinian region has been largely limited to coverage by atlas and other volunteers.

Preliminary findings from the habitat modelling work by Flaxman (2004) can be used to make a rough estimate of the amount of potential habitat that has not been searched. Flaxman (2004) found that half of the occupied sites are in or near protected areas, but only one quarter of the 70,000 ha of potential habitat was in or near protected areas. If correct, these figures suggest that roughly half of the potential Acadian Flycatcher habitat in southern Ontario has not been surveyed. This assumes that potential habitat is evenly distributed throughout the EO, which is probably not the case, because private lands are generally exposed to higher intensities of forest management than public lands.

Abundance

Abundance data collected by general large-scale bird monitoring programs from the Canadian range are too sparse (only a few detections on BBS, FBMP and OBBA2 point counts) to be used to calculate a meaningful estimate of the Canadian population. Counts of the number of Acadian Flycatcher territorial males detected in directed searches in 1997, 1998, 2002, and 2007 are available (Table 2). The figures reported in Table 2 include unmated, monogamously paired and polygynous males, and males whose breeding status was not determined. These counts cannot be directly converted into number of breeding pairs or adults. Nevertheless, the survey data can be used to estimate the size of the Canadian population.

In the 2007 surveys, 36 Acadian Flycatcher males were found at 25 sites in six counties/regions (Table 2; Heagy and Badzinski 2008). Multiple territories (up to 3) were found at eight sites. Eight sites had records of a single male found on only one occasion. Assuming that half of the eight males detected only once were migrants or transients and that no birds were missed at any of the survey sites, then the minimum number of territorial breeding males was 32. Using average pairing success (70%) and polygyny (20%) rates for the Ontario population (see **Life Cycle and Reproduction**), the 2007 count is estimated to consist of approximately 10 unmated territorial males, 18 monogamous pairs, and 4 polygynous groups (each consisting of one male and two females), for a total count of about 56 adults (32 territorial males and 24 paired females).

Population Estimates

To estimate the total population, a further extrapolation is needed to account for the proportion of the population that occurs on sites that were not surveyed in 2007. Given that search effort on private lands is limited and that a few new sites are being found every year, it is clear that a number of birds are being missed during these periodic surveys. However, given the consistency of past survey results, it seems probable that about half of all occupied sites were included in the 2007 surveys. Thus, the Canadian population in 2007 is estimated to be about double the actual counts, or 112 adults (64 territorial males or 48 pairs). This estimate is consistent with previous population estimates (Table 3).

Given the range of reported year-to-year fluctuations in the Ontario population (+/- 50%), the current Acadian Flycatcher breeding population in Canada is estimated to be approximately 50 (range of 25-75) breeding pairs (including some polygynous pairs), or 64 (range 32-100) territorial males, or 112 (60-180) adults.

Fluctuations and trends

Available information suggests that the Acadian Flycatcher population in Canada has been relatively stable over the past decade, and stable or increasing modestly over the past few decades. Recovery Team count data (Table 2) provide evidence that the small population within the Carolinian region has been fairly stable since 1997 (Heagy *et al.* 1997; McCracken *et al.* 1998; Carson *et al.* 2003; Heagy and Badzinski 2008). At a finer scale, numbers of birds at the site and county level have fluctuated over the past few decades, with local declines and extirpations in some areas (e.g., Chatham-Kent sites, see Table 2) being offset by more birds and additional occupied sites in other areas (e.g., Norfolk County). These additional sites include historic sites that have been re-occupied, previously unoccupied sites that have been newly colonized, and birds found at sites that have not been previously surveyed. As new sites are discovered, the total number of known sites has gradually increased. However, the number of sites occupied in any given year has been fairly stable.

Table 2. Acadian Flycatcher count data for southwestern Ontario, 1997-2007 (adapted from Heagy and Badzinski 2008). Figures reported are the number of males found with at least possible breeding evidence (singing or in suitable habitat). NS = no sites surveyed; 0 = site(s) surveyed but no birds detected.

County/Region	1997 count	1998 count	2002 count	2007 count
Brant	NS	0	1	0
Chatham-Kent	10	7	2	0
Durham	NS	NS	0	0
Elgin	2	11	11	5
Essex	5	2	0	2
Haldimand	0	0	0	0
Halton	0	0	0	0
Hamilton	0	0	2	0
Lambton	1	1	3	4
Middlesex	2	1	9	7
Niagara	NS	0	0	1
Norfolk	14	7	8	17
Oxford	0	0	0	0
Waterloo	0	0	0	0
York	NS	NS	0	0
Total	**34**	**29**	**37**	**36**
Number of Counties/Regions	**6**	**6**	**7**	**6**

Ontario Breeding Bird Atlas results also suggest a stable or increasing population over the past two decades. The effort-adjusted probability of observation for Acadian Flycatcher in Ontario increased significantly (by 86%) between the first (1980-85) and second (2001-2005) atlases (Cadman *et al.* 2007). However, as Martin (2007) notes, much of the recent increase can be attributed to directed searches carried out by experienced field biologists working on behalf of the Recovery Team rather than an actual increase in numbers.

McCracken *et al.* (1998) suggested that the Ontario breeding population exhibits considerable year-to-year population fluctuations. Fluctuations in the numbers reported on spring migration in Ontario also indicate that periodic influxes of birds (presumably overshoots from the United States) occur in some years, presumably prompted by certain weather conditions that occur during migration. These influxes may double the population in some years (Friesen *et al.* 2000). Marked year-to-year differences in pairing success suggest that the sex ratio of these influxes is skewed towards males, which is consistent with the observed differential timing of spring migration by sex.

A preliminary population and habitat viability analysis for the Acadian Flycatcher in Ontario suggested that the Canadian population is not self-sustainable and may become extirpated without a continuous influx from external populations (Tischendorf 2003). The study predicted a 93% risk of extirpation after 100 years, given a starting population size of 30 breeding pairs and no immigration. Simulation experiments using this model suggested that one immigrating breeding female every 2 years may be sufficient to eliminate the extinction risk. However, the conclusions should be viewed as preliminary, because the study was based upon limited data and conservative estimates.

Table 3. Population counts and estimates for the Acadian Flycatcher in Canada (1987-2007).

Source	Population Count	Population Estimate	Information Used
Heagy and Badzinski 2008	36 males at 25 sites in 2007	Actual numbers estimated to be 10% to 50% higher than count	2007 survey data
Martin 2007	50 atlas squares with breeding evidence over 2001-05 period	Between 27 and 35 pairs in any given year	OBBA2 and Recovery Team data
Tischendorf 2003		30 pairs plus 5 single males	Stutchbury pers. comm.
Carson *et al.* 2003	37 males at 22 sites in 2002		2002 survey data
James 2000		Fewer than 50 pairs likely remaining	1981-1999 data and reports.
McCracken *et al.* 1998	26-29 territorial males at 14 sites in 1998	35-50 territorial males (including many unpaired birds)	1998 survey data
Heagy *et al.* 1997	34 territorial males at 13 sites in 1997	20-100 pairs (probably fewer than 50 pairs)	1997 survey data
Austen *et al.* 1994		40 to 75 pairs	OBBA1 data, 1981-85, ORBBP data 1989-91
Page and Cadman 1994		41 to 75 pairs, probably closer to the lower figure	OBBA1 data, 1981-85, ORBBP data 1989-91
Woodliffe 1987	29 atlas squares with breeding evidence over 1981-85 period	Abundance estimates of 1 bird in 6 squares, and 2-10 birds in 4 squares. No estimates available for the other 19 squares	OBBA1 data, 1981-1985

Rescue effect

The observed pattern of intermittent site occupancy (site turnover) is consistent with the Canadian Acadian Flycatcher population functioning as a metapopulation, with populations at the site level being semi-isolated and vulnerable to local extinction but linked by dispersion from other sites (Environment Canada 2004). Dispersal rates are not sufficient to prevent site turnover, but appear to be sufficient to maintain the overall Canadian population. The source of most of the colonists is likely outside of Canada, because the very small Canadian population is near areas of high population density in the United States (e.g., ~200,000 adults in Pennsylvania and ~290,000 in Ohio; PIF 2008).

Immigration of individuals from the United States may be essential to maintaining the overall Canadian population (Tischendorff 2003; Martin 2007), provided that suitable habitat is retained here. As such, declines or reduced productivity in Acadian Flycatcher populations in adjacent jurisdictions could adversely impact the Canadian population. The continental BBS trend of -0.1%/yr (p=0.61, *n*=973) for the period 1966-2007 is not statistically different from zero and suggests that the Acadian Flycatcher population has remained relatively stable across its North American range over the past 50 years. Similarly, the continental trend for the past 10 years (1997-2007) shows a non-significant decline of 0.45%/yr (p=0.33, *n*=717; Sauer *et al.* 2008).

BBS long-term trends for Ohio and Pennsylvania over the 1966-2007 period show declines of 2.3%/yr (p=0.04, *n*=53), and 0.4%/yr (p=0.28, *n*=78), respectively (Sauer *et al.* 2008). For the most recent 10-year period (1997-2007) the comparable BBS trends are +0.92%/yr (p=0.54, *n*=35) and +0.55% (p=0.65, *n*=55), indicating that earlier declines in these jurisdictions show signs of levelling off (Sauer *et al.* 2008). BBS trends for New York and Michigan are not reliable due to small sample sizes (Sauer *et al.* 2008).

Atlas data from adjacent jurisdictions (New York, Pennsylvania, and Ohio) show stable or increasing trends. In the second New York atlas, there was an effort-adjusted 47% increase (not statistically significant) in the number of atlas squares with Acadian Flycatcher breeding evidence for the 2000-05 period compared to the 1980-85 atlas (Smith 2008). Acadian Flycatchers are also being reported more widely in atlas projects currently underway in Ohio and Pennsylvania compared to the previous state atlases completed in the 1980s (Ohio BBA II 2008; Pennsylvania BBA 2008).

The global population is estimated at 4,700,000 individuals (Rich *et al.* 2004; PIF 2008). The reliability of this estimate, which is based on BBS data, is considered good (PIF 2008). Seventy-five percent of the population breeds in three Bird Conservation Regions (BCRs) with extensive forest cover: the Appalachian Mountains, Southeastern Coastal Plain, and Central Hardwood regions. The nearest core breeding population, in the heavily forested central Appalachian Mountains, is about 250 km from the Canadian population. An estimated 52,000 birds (1.1% of the global population) breed in the fragmented forests of the Lower Great Lakes/St. Lawrence Plain BCR, which includes southern Ontario, the south shores of lakes Erie and Ontario (New York, Ohio and Pennsylvania), and the St. Lawrence River valley (Quebec and New York) (PIF 2008).

THREATS AND LIMITING FACTORS

Studies of Acadian Flycatcher breeding success have shown that this species is sensitive to site-, patch- and landscape-scale effects. At least in some settings, productivity of this species is negatively impacted by openings in the forest canopy, anthropogenic edges, increasing forest fragmentation, and urbanization (Whitehead and Taylor 2002; Bakerman and Rodewald 2006; Hoover *et al.* 2006; Becker *et al.* 2008; Rodewald and Shustack 2008; Rodewald 2009). However, the response to these factors is not always consistent across the breeding range, possibly because these site and edge effects can be masked by the impact of more pervasive landscape-level effects (Robinson and Robinson 1999; Bell and Whitmore 2000; Hazler *et al.* 2006; Chapas-Vargas and Robinson 2006; Chapas-Vargas and Robinson 2007).

Small population size

The Acadian Flycatcher population in Canada may not be self-sustaining due to its small size and scattered distribution. The total Canadian population consists of an estimated 50 mated pairs (25-75 pairs in any given year) with an IAO of ≤200 km^2 scattered over a relatively large area (EO of some 35,000 km^2). Observed pairing success rates in Ontario are highly variable from year to year but are considerably lower (70% average at core sites) than observed in areas of higher population densities (91% average over 4 years in a Pennsylvania study area; Woolfenden *et al.* 2005). Population viability is further compromised by reduced seasonal reproductive output, most likely due to reduced habitat quality (e.g., fragmentation, proximity to forest edge) that leads to elevated rates of nest predation and brood parasitism. Persistence of the Canadian population is believed to be dependent on immigration from the large population in adjacent states (especially Ohio and Pennsylvania).

Habitat degradation on breeding grounds

Forest habitats within the Acadian Flycatcher's restricted breeding range in Canada are generally compromised in terms of their ability to support area-sensitive forest birds. Habitat degradation has occurred, and is occurring, at all scales. Regional forest cover is below the 30% minimum guideline for sustaining forest bird biodiversity (Environment Canada 2004) in all parts of the Carolinian region, and is less than 5% in some parts of the region.

Remaining forest habitat mostly consists of small, isolated, and highly fragmented patches, with only a few hundred patches over 100 ha and little interior area more than 200 m from a forest edge. Virtually no forested areas in the Carolinian region are more than 600 m from the nearest edge, which was found to be the effective extent of forest-edge sink habitat in a study in moderately fragmented forest in Illinois (Hoover *et al.* 2006). Again, however, the extent to which this figure can reasonably be extrapolated to the southern Ontario situation is debatable, given the species' affinity for linear, relatively narrow belts of ravine habitat here.

Nest predators and brood parasite populations are likely at elevated levels in most forests in the agricultural-dominated landscape of southern Ontario, as in Illinois (Chapas-Vargas and Robinson 2006).

Habitat within the existing forest patches is also degraded in that most forests in southern Ontario are exposed to logging that targets the removal of mature trees. All are also impacted by an extensive list of invasive species (fungi, insects, disease, earthworms, plants, etc.) that have fundamentally altered forest composition, structure and ecological functions. Widespread agricultural drainage has also dramatically altered water tables and moisture regimes. On a finer scale, habitat degradation has been observed at several Acadian Flycatcher sites due to heavy logging, the spread of invasive alien plants, and new house construction (Recovery Team data).

Several of the Acadian Flycatcher's preferred nest tree species (hemlock, beech, flowering dogwood) are being decimated by invasive forest pests and pathogens (Hemlock Wooly Adelgid, beech bark disease, and dogwood anthracnose) in the northeastern United States. Eastern Hemlock is a particularly important nesting tree in the northern part of the Acadian Flycatcher's range (Allen *et al.* 2009 and references cited therein). Allen *et al.* (2009) predicted a significant decline in Acadian Flycatcher populations and range contractions in the northeastern U.S., particularly in the Appalachian Highlands, owing to large-scale mortality of hemlock from wooly adelgid infestations. This insect currently occupies nearly half of the hemlock's range, and is spreading northward at an annual rate of ~20 km (see Allen *et al.* 2009). Infestations are currently only about 200 km from Ontario. If this insect spreads into southern Ontario as expected, then large-scale mortality of hemlock will quickly follow, effectively decimating the amount of suitable nesting habitat for Acadian Flycatchers in ravine situations.

In tableland situations, the threats posed by beech bark disease and dogwood anthracnose are equally severe. For example, until recently, flowering dogwood was a fairly common shrub in parts of southern Ontario within the Acadian Flycatcher's primary breeding range. In 2007, it was assessed by COSEWIC as Endangered, owing to the rapid spread of anthracnose.

Habitat loss

Any further fragmentation or conversion of forest habitat in the Carolinian region is of particular concern, given the current conditions (low regional forest cover and high fragmentation). Despite improved protection available for woodlands in southern Ontario under the *Planning Act* and county tree-cutting bylaws, conversion and encroachment on forests for agriculture, rural residential developments, utility corridors, and urban sprawl is still occurring. This outright habitat loss is being partially offset by tree planting and ecological restoration efforts (which have increased in recent years), and by strategic efforts to expand interior forest conditions in core forest complexes known to be important to this species. However, it will take many decades before such habitat reaches sufficient maturity to support Acadian Flycatchers.

Although deforestation of the wintering grounds is a potential concern, there is no strong evidence that habitat loss there is affecting Canadian or North American breeding populations of Acadian Flycatchers.

PROTECTION, STATUS AND RANKS

Legal protection and status

The Acadian Flycatcher is protected in Canada under the *Migratory Birds Convention Act (MBCA* 1994). This legislation prohibits the possession or sale of migratory birds and their nests, and activities that are harmful to migratory birds, their eggs, or their nests, except as permitted under the *Migratory Bird Regulations*. This species also receives legal protection in the United States and Mexico under similar legislation.

The Acadian Flycatcher was first designated as Endangered in Canada by COSEWIC in April 1994, and this status was last re-examined and confirmed in November 2000. It is presently listed as Endangered under Canada's *Species at Risk Act (*SARA 2002), Schedule 1. SARA prohibits harming or possessing a listed species, or damaging its residence or critical habitat. Once critical habitat is identified under SARA, only those portions present on federal lands will be protected. The Acadian Flycatcher is also listed as Endangered under Ontario's *Endangered Species Act, 2007* (ESA; Ontario Ministry of Natural Resources 2008a, b). The Ontario ESA protects listed species from harm. However, unless a regulation is made earlier, habitat protection for this species will not be in place until June 2013.

Non-legal status and ranks

This species is ranked as Least Concern on the IUCN Red List by BirdLife International (BLI) and as Globally Secure (G5) by NatureServe (BLI 2004; NatureServe 2008). In Canada and Ontario, the Acadian Flycatcher is ranked as Imperiled (N2B and S2B; NatureServe 2008; NHIC 2008). It is considered common and not of conservation concern in most jurisdictions within its breeding range in the United States but is ranked as Vulnerable (S3) in all states bordering Ontario other than Pennsylvania (S5) and Ohio (S5; NatureServe 2008).

The Acadian Flycatcher is identified as one of 195 species of Continental Importance in the North American Landbird Conservation Plan because 98% of its global population breeds within the Eastern Avifaunal Biome, and agencies in that avifaunal region have a high stewardship responsibility for the conservation of this species (Rich *et al.* 2004). Due to its current Endangered status, the Acadian Flycatcher is identified as a Priority Species in the landbird conservation plan for southern Ontario (OPIF 2008).

Habitat protection/Ownership

About half of the known Acadian Flycatcher sites in Ontario are on publicly owned lands, but most of these sites are working forests that are being actively managed for timber and fuelwood production (Recovery Team unpubl. data). Land ownership and habitat protection statistics for the known population overestimate the overall level of protection of the population, because survey effort has focused on protected areas and public lands.

Acadian Flycatchers have not been confirmed breeding on federal lands in Ontario. Territorial birds are reported fairly regularly during early summer at Point Pelee National Park, but breeding has not been confirmed (Wormington 2006). There are also some summer records of territorial males at the Long Point and Big Creek National Wildlife Areas, but these are believed to have been unmated birds (J. McCracken pers. comm. 2009). One known breeding site is on First Nations lands at Kettle Point (Recovery Team unpubl. data).

Seven of the known sites (breeding evidence since 1980) are in provincial protected areas (parks, nature reserves, or conservation reserves; Recovery Team unpubl. data). Several of the other known sites are managed as protected areas by municipalities, conservation authorities, non-profit conservation organizations, or private landowners.

The *Ontario Planning Act* and the *Provincial Policy Statement* (PPS) discourages development in the "significant habitat" of endangered and threatened species, including the Acadian Flycatcher (OMMAH 2005). The PPS also provides some protection to forests, including enabling municipal tree-cutting bylaws, and providing protection for designated significant woodlands and valley lands. All counties in the Carolinian region now have tree-cutting bylaws except for Essex and Chatham-Kent (OWA 2009). Several municipalities have designated significant wildlife habitat, significant woodlands and valley lands in their Official Plans. Planning decisions requiring municipal approval must be consistent with the PPS. The Ontario *Endangered Species Act, 2007* (ESA 2007) and the federal *Species at Risk Act* do not currently afford protection to Acadian Flycatcher habitat, although designation of critical habitat on federal lands is anticipated in the near future.

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Previous COSEWIC status reports on this species were produced by Ross James (2000), and Annette Page and Mike Cadman (1994).

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Audrey Heagy is a Bird Conservation Planning Biologist with Bird Studies Canada, a non-profit, non-governmental bird research organization with headquarters in Port Rowan, Ontario. Since 1990 she has worked as a biologist for non-profit environmental organizations and consulting firms. She has more than 10 years' work experience focusing on birds at risk, breeding bird surveys, bird banding, migration monitoring, and landbird conservation in Ontario. She was the Regional Coordinator for the Long Point region for the Ontario Breeding Bird Atlas from 2003-05. She has been actively involved in Acadian Flycatcher recovery efforts in Canada since 1997, including coordinating and compiling the southern Ontario breeding distribution surveys in 1997 and 2007. Due to her extensive field experience, she is familiar with most of the known Acadian Flycatcher breeding sites in Ontario. She has authored and edited numerous technical reports and was recently the lead writer for three regional landbird conservation plans for Ontario.

COLLECTIONS EXAMINED

No collections were examined.